Long-term human health risks assessment at contaminated sites employing a system dynamics model

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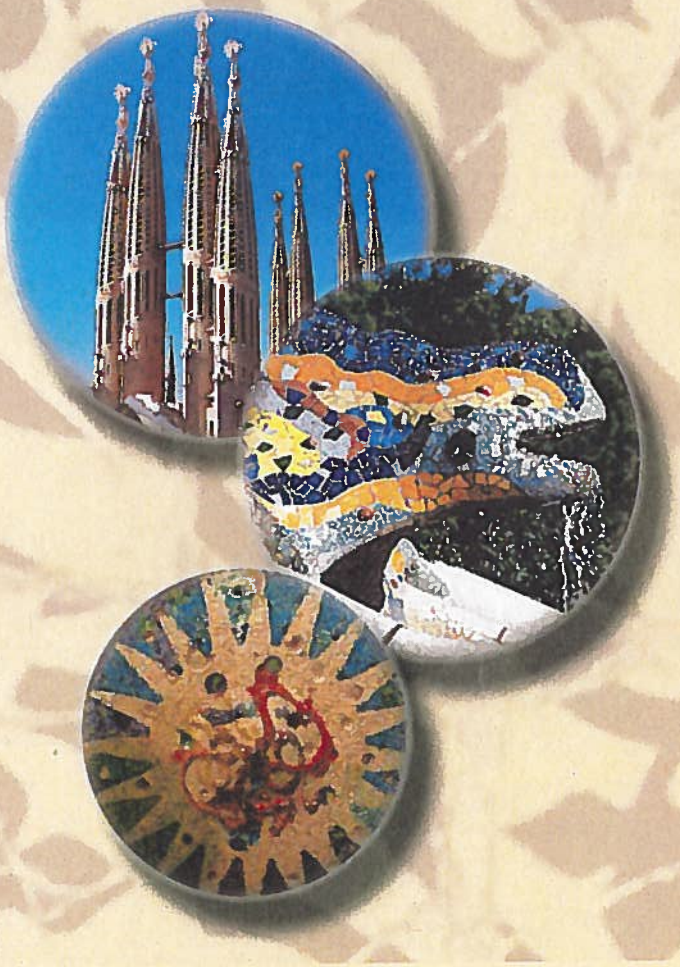

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fraction analyses of about 75 sites in the Netherlands in Belgium were used. From these data it became clear that for 2/3 of these samples the conclusion is the same and that for 1/3 the risk based approach is more critical than the total concentration approach. Especially the ecotoxicological risk assessment contributes to the identification of more seriously contaminated sites. Based on these data it is possible to set a trigger value below which it is efficient not to carry out the fraction approach. A trigger value for human and ecotoxicological risks for the total of petroleum fractions from C10 to C40 will be about 500 mg/kg, and 100 mg/kg, respectively. A trigger value for human and ecotoxicological risks for the total of fractions from C5 to C10 it will be about 30 mg/kg and 20 mg/kg, respectively. The level of the quality standard for seriously contaminated soil (based on ecological and human risks) should be lower than the current value of 5000 mg/kg. Nevertheless, the exact level will depend on the type of oil.
Based on these results and the available assessment and analytical methods from ISO it is possible to implement the risk based fraction approach on a European level, when a trigger value is used before full fractionation is performed.

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LONG-TERM HUMAN HEALTH RISKS ASSESSMENT AT CONTAMINATED SITES EMPLOYING A SYSTEM DYNAMICS MODEL

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For the design of sustainable and cost-effective management strategies for contaminated sites, decision makers need appropriate tools to assist them in the planning, assessment, selection and optimisation of possible alternatives.
We propose a system dynamics model, which provides estimates of current and future risks originating from soil and groundwater contamination. At the core of this concept is a modelling-based, multi-compartmental environmental impact assessment designed to establish the suitability of management scenarios capable of meeting pre-defined, site-specific compliance criteria. Conducting a risk assessment for multiple, or projected uses of a site the decision-maker can begin to have an idea about what use restrictions or modifications might be necessary for a particular type of receptor.
Utilising a source-pathway-receptor concept, the model particularly addresses the presence of multi-compound non-aqueous phase liquids in porous media, which have been identified as major sources of groundwater contamination at many of these sites. Simplified approaches for the description of contaminant release and transport, as well as of exposure pathways for human health risk assessment, allow for a fast and effective screening model, which is particularly qualified to support early decisions within a tiered management approach at contaminated sites.
The model is applied to assess the long-term risks originating from a kerosene contamination at a former military airfield in Germany. Monte Carlo simulations are performed to account for the large uncertainty in model parameters at early decision levels. The results of the application show that the implementation of monitored natural attenuation might be a feasible management strategy for the site, and provide guidance for additional, more detailed investigations. The results substantiate initial investigations in the application of risk management methods by segregating and quantifying the role of relevant parameter categories. This allows the risk assessor to subsequently undertake target-oriented detailed investigations to narrow down uncertainty.

RISK BASED ASSESSMENT IN PETROL STATIONS, TOTAL PETROLEUM HYDROCARBONS STUDY

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Products derived from petroleum like gasoline, diesel or lubricants can be released and spread out to soil. Those spills can affect soil, causing risks to human and environmental receptors [1]. To study all the substances that are usually found in petroleum spill, it results interesting to apply the study to the Total Petroleum Hydrocarbons (TPH), containing many hundreds of derived petroleum products. As policies for contaminated site management are changing to risk-based approaches, TPH must be divided into different groups according to their physico-chemical properties. A risk based approach is available for estimation of effects on humans [2], and the ecosystem [3].
The purpose of this work is to establish the human and ecotoxicological risks that may arise from a specific TPH fractions concentration. The study is focused on a high populated area of a medium size city (Santander, 182000 inhabitants).
Physicochemical properties and toxicity values for each fraction must be applied, as proposed in previous work [4]. The selected compounds were TPH fractions, due to their toxic effects [5] and applying TPH concentration of a specific site [6].
The human risk-based approach is carried out applying the CSOIL assessment tool, used for determining the human risk due to the exposure to contaminated soils [7]. Hazard Quotient (HQ), with a maximum limit value of 1 for an acceptable risk, is the assessed parameter. Ecotoxicological risks are obtained by using Species Sensitivity Distributions (SSDs) applied to statistically derive the Potential Affected Fraction (PAF) from a Hazardous Concentration. Internal lipid concentrations are implemented to obtain the ecotoxicity of the tested species [3]. The applied curve fits data as a cumulative log-normal distribution. An adverse effect to 50% of population is defined as HC50 to finally obtain the Toxic Ratio (TR).
Based on the results it is possible to determine the risk to human health and the environment and establish the critical receptor of the contamination.

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